crown of the affected plant, and frequently occur an inch or two up on the stem. Though usually small, or in an irregular divided mass, they may be round and unbroken, and three or four inches in diameter. The interior of the gall is composed of small, irregular cavities in the hypertrophied tissue, the chambers being filled with masses of brown resting spores about forty micro-millimeters in diameter.

A more detailed account of the disease as it occurs in California will be published shortly.

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June 2, 1909

THE WEST INDIAN SEAL AT THE AQUARIUM

THE New York Aquarium received on June 14, 1909, an adult male and three yearling specimens of the rare West Indian seal (*Monachus tropicalis*). One of the latter was in a weak condition and died the day after arrival. The others are apparently doing well. The specimens were procured from a dealer in live turtles at Progresso, Yucutan, who reported the species as a great rarity. They were presumably captured at either the Triangle or the Alacran islets in the Gulf of Campeachy, the only known resorts of the species at the present time, so far as I am aware.

They are probably the only specimens of this nearly extinct species now living in captivity. Its original range included the coasts of Cuba, Haiti, Jamaica and the Bahamas. For the last half century it has apparently been restricted to the islands of Yucatan. It was well known to the sailors of Columbus and was later the basis of a seal fishery.

In SCIENCE for April 13, 1906, I recorded the killing of a specimen at Key West, Florida, on February 26, 1906. The species had not been seen in Florida for about thirty years.

The New York Aquarium received two specimens in 1897, one of which lived in the aquarium until 1903. Both of these animals had the singular habit of filling their cheeks with water and blowing it suddenly and with considerable force into the faces of visitors leaning over the pool. It will be interesting to discover whether the specimens now in the building develop this trick, which for years excited the amusement, and sometimes the wrath, of visitors. Unlike the other Phocidæ kept on exhibition here, *Monachus* is noisy, the young often roaring harshly.

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SCIENTIFIC BOOKS

Scientific Papers. By SIR GEORGE HOWARD DARWIN. Cambridge, at the University Press. Vol. I., pp. xiv + 459; Vol. II., pp. xvi + 514.

The task of the reviewer who undertakes the consideration of a republication of matter which has been for some years before the public in an accessible form, is not particularly easy. He may, of course, take refuge in statements more or less detailed of the contents of the volumes before him and say little more than the intelligent reader can glean by turning over the pages himself. Or he may write a few paragraphs on the history of the subjects treated, showing the author's relation thereto and his place in their development. More often he seizes a few points of a controversial character and in discussing them simply adds to the literature of the subject. No one of these methods appears to be satisfactory from the point of view of the reader. Brief reviews not intended for serious study, although they may be the result of such study, should, it seems, be written chiefly to save time and labor for the reader and perhaps to express the opinions of the reviewer, since in scientific journals at least the editorial "we" has ceased to be even a disguised fiction. Such reviews thus necessarily pass into the class of ephemeral productions which may have value at the time of publication, but which only add to the labor of future students if they contain matter belonging properly to the development of the subject.

If a writer accepts this view and takes to the criticism of matters beyond the mechanical detail of form and arrangement, an estimate of the writer and his work, however dangerous, is necessarily the main topic. After all, such criticism is merely a single opinion as to whether the attitude of the scholar towards his

work, his methods and his manner should or should not be recommended for the guidance of those who wish to aim at similar achievements. This at any rate is true with respect to works like the one before us, their intrinsic value not being open to question. In reading such productions, especially in collected form, one necessarily forms a picture, conscious or otherwise, of the author's mind quite apart from any personal acquaintance, and it may be that no apology is needed for recording such an impression and for pointing out some features of the author's work and methods which appear to the present reviewer to be of high value in the study of applied mathematics.

The lines on which Sir George Darwin has so far published memoirs have been mainly laid in the subject of hydromechanics and its mathematical associate, the theory of elastic solids. These have been applied to masses in bulk and subject to the Newtonian law of gravitation with applications to present-day astronomical and geophysical problems and to theories of cosmogony on the basis of a continuous evolution of planetary and satellite systems. These problems, whether we consider them from the mathematical or physical side, are certainly the most difficult of all the studies in celestial mechanics which have received attention in the past. It is true that there are many ideal problems which admit of moderately simple treatment, but the majority of these can not be considered even as a first approximation to the real problems presented by the observed phenomena. One notices throughout Professor Darwin's work that he rarely takes up an ideal problem without having in view the ultimate answer to some physical question. Almost the single exception to this is his paper on periodic orbits, and the possible complications of solar systems other than that to which we belong makes this exception a doubtful one.

The difficulties are increased when it is desired either to interpret the mathematical results in terms of simple and easily understood phenomena or to put them into such forms that numerical values may be substituted directly for the symbols. These objects Professor Darwin appears to have continually in view. He is rarely contented with the mathematical solution of a set of differential equations, however intricate or interesting the solution may be from the symbolic point of view, but searches to find the physical explanation or analogy which will enable him and the reader to follow without great mental effort the various sequences of events which must result from the formulæ obtained.

One notices too the wide range between what are popularly called "practical results" and speculative theory. On the one hand, we have his work on tidal prediction with all its associated problems, solutions of which are necessary or valuable in the concerns of daily life, and on the other hand, the highly speculative (I use his own term) investigations into the past history of the satellites and planets which form our solar system. In the former case the object in view was chiefly the discovery of methods for obtaining the times and heights of the tides at any place without excessive labor, that is, in these days when numerical computation is a recognized profession, at a cost which is within the means of those who desire the results. In such work the mathematical developments have generally a minor interest: they are considered to be merely tools for the fashioning of the machine under construction. At the other end of the scale is the work of purely scientific interest related to problems of cosmogony, chiefly those of the past, in which the mathematical developments frequently have an interest of their own and give rise to problems in pure mathematics which may be entirely separated from any physical considerations.

In using the term "highly speculative" it is well to distinguish between work of the character of Darwin's theory of the lunar evolution based on known physical data clearly stated, developed with rigid mathematical accuracy and with careful attention to any factors which may modify the results, and the ill-defined guesses developed, it may be, from some isolated principle which not infrequently appear as proofs of the correctness or falsity of some new or old idea. In the matter of cosmogony this has been especially obvious of

late years, and nowhere more so than in the attempts to trace back astronomical systems to an earlier state on the theory of a general evolution of the arrangement of matter. One can not read Sir George Darwin's work in this line without being impressed with the caution which he continually exercises and wishes to impress on the reader for any results, especially those which are numerical, that he may print. It is interesting to learn his own opinion of the outcome of the controversies which have sprung from the theories set forth years ago in his papers, and I can not do better than to quote his estimate as given in the preface to Volume II. In referring to the papers on Tidal Friction and Cosmogony, which fill this volume, he says:

For the astronomer who is interested in cosmogony the important point is the degree of applicability of the theory as a whole to celestial evolution. To me it seems that the theory has rather gained than lost in the esteem of men of science during the last twenty-five years, and I observe that several writers are disposed to accept it as an established acquisition to our knowledge of cosmogony.

Undue weight has sometimes been laid on the exact numerical values assigned for defining the primitive configuration of the earth and moon. In so speculative a matter close accuracy is unattainable, for a different theory of frictionally retarded tides would inevitably lead to a slight difference in the conclusion; moreover, such a real cause as the secular increase in the masses of the earth and moon through the accumulation of meteoric dust, and possibly other causes are left out of consideration.

The exact nature of the process by which the moon was detached from the earth must remain even more speculative. I suggested that the fission of the primitive planet may have been brought about by the synchronism of the solar tide with the period of the fundamental free oscillation of the planet, and the suggestion has received a degree of attention which I never anticipated. It may be that we shall never attain to a higher degree of certainty in these obscure questions than we now possess, but I would maintain that we may now hold with confidence that the moon originated by a process of fission from the primitive planet, that at first she revolved in an orbit close to the present surface of the earth, and that tidal friction has been the principal agent which transformed the system to its present configuration.

After some remarks on the difficulties in the way of the acceptance of the theory due to the time element and the probable date of solidification he refers to the arguments of Lord Kelvin based on temperature gradients and points out how the possible effects of radioactivity and the "colossal internal energy resident in the atom" may tend to nullify any estimates based on temperature alone. Summing up, he adds:

It is very improbable that tidal friction has been the dominant cause of change in any of the other planetary sub-systems or in the solar system itself. Yet it seems to throw light on the distribution of the satellites amongst the several planets. It explains the identity of the rotation of the moon with her orbital motion, as was long ago pointed out by Kant and Laplace, and it tends to confirm the correctness of the observations according to which Venus always presents the same face to the sun.

The arrangement adopted for the order of the papers is not entirely chronological. Professor Darwin remarks that in the case of his own work, his papers fall into a few well-defined groups and that this fact furnished him with the opportunity to place together those papers which deal with particular subjects. As a result of this arrangement the first part of Volume I. consists of what is practically a treatise on the tides and tidal prediction, the second part containing two papers on the lunar disturbance of gravity, while the whole of Volume II. is devoted, as stated above, to tidal friction and cosmogony. Appended to each volume is a chronological list of all his papers with references to the volumes in which they are or will be contained.

The collection will thus be something more than a reprint. In general the reproduction is literal, but here and there are notes pointing out an occasional error or giving a reference to later work by himself or others which has tended to modify the earlier conclusions or to fill gaps which had existed. One sometimes wishes that these notes had been more frequent so as to include references and perhaps

brief accounts of later work. However, for the greater part of these two volumes, the article Bewegung der Hydrosphäre in Vol. VI., 1, 6, of the "Encyklopädie der mathematischen Wissenschaften," by Darwin and Hough, will be found to supply these needs. This article is to be reproduced, it is to be hoped in English, in Volume IV. of the "Scientific Papers."

I may mention one point in conclusion in connection with Sir George Darwin's presentation of his work which earns the gratitude of those who are unable from want of time or training to read his papers in detail as well as of those who do such reading but wish to get a general view of his processes and results as a first step. In the summaries to the longer memoirs he gives not only the general conclusions at which he has arrived, but also a brief account, without symbols, of the hypotheses on which the arguments are based, the methods employed and the general course of the mathematical procedure. These summaries have made the task of following his work very much less difficult and have doubtless contributed in some measure to the early acceptance of the theories which he has set forth.

The printing done by the Cambridge University Press is too well known to need comment here. The size of the volume adopted is the modern compromise between convenience for the printing of long formulæ and suitability of size for easy handling and reading, namely, the royal octavo between one and two inches thick.

ERNEST W. BROWN

The Problem of Age, Growth and Death: A Study of Cytomorphosis based on Lectures at the Lowell Institute, March, 1907. By CHARLES SEDGWICK MINOT. New York and London, G. P. Putnam's Sons. 1908. Pp. 280; good index.

Many biologists, and with them a wide circle of people who are intelligently interested in fundamental problems of life, have followed Professor Minot's researches in this field with keen interest for thirty years past, and will be glad to have the many scattered papers collected in book form and brought down to date. The purpose of the book is stated in the elaborate "introductory letter," which is addressed to Senator Mosso, to whom the work is inscribed. It is a study of "increase in the amount of protoplasm" as compared with the bulk of nucleus in the cells of the growing animal.

The first lecture deals with the process of growing old as seen in the body as a whole; and while the familiar data are exceptionally well presented, it calls for no special review. The second lecture, "Cytomorphosis—the Cellular Changes of Age," carries a somewhat parallel line of thought through the microscopical changes in the cells and tissues from the germinal to the senescent condition. Here we learn, in connection with appropriate figures in the text, about the "cytomorphic cycles" of different cells, connective tissue, nerve, muscle, gland and blood; and of the death and old age of cells in atrophy or degenerations of various kinds. As cells differentiate from the germinal to the adult form they become fitted to perform specialized functions, but lose the germinal power of growth and regeneration. Thus death is continually present in life, and may be even more active in the embryo, as, in the rapid whirl of cell-life, whole organs form and vanish, than during any other period of life. In fact one of the main theses is that: "The period of most rapid decline is youth; the period of slowest decline is old age."

The third lecture—"The Rate of Growth," gives the results of the author's extensive studies on the growth of guinea-pigs, rabbits and fowls and correlates them with those of Quetelet, Donaldson, Muhlmann and Thoma for man. The facts are presented with great precision in text, table, series of figures of embryos and by most striking charts and curves, growth being expressed, in the main, in percentage increments. The chief result is that power to grow is greatest in the germ and decreases rapidly with age. For example, using Richard Hertwig's calculation, the fertilized human ovum is 0.004 of a cubic millimeter; the child at birth from 3 to 4,000,000 cubic millimeters, which shows an increase of one billion times the original mass during gestation. From birth on to twenty years of